the sea-serpent: whether we refer what was seen to long lines of ducks now dropping out of sight in the trough of the wave, now rising in thick coil over its crest; or to water-logged baulks of timber with seaweed hanging like a mane about the ends, which were protruded or submerged with the rise and fall of the waves; or whether we accept Günther's explanation of the best authenticated case on record, which he described as a sperm whale attacked by an octopus, the dimensions of which he calculated from known examples; we admit the stories and discuss only the explanations, which in these last cited cases must differ so much.

So for Mr. Day's story of the fox and the fleas; we may examine it from several points of view. If it is a true natural history story it is extremely improbable that Mr. Day's was the first and only recorded fox who showed this instinct, or, as Samuel Butler would call it, "memory"; and, thanks to many friends, I can give more or less clear references to previous observations of the same kind. Mr. Nichols tells me that he has heard it mentioned as a story current among Celtic people—likely enough, as they are chiefly pastoral and close observers of natural phenomena. Mr. Grey in his letter, which by your courtesy I have seen, thinks he remembers it as belonging to Gascony. But the most important contribution to the discussion, so far, is a reference sent by my friend and pupil Mr. Frank Barclay, which I have verified in the university library.

Olaus Magnus, writing in 1555, says:—

"Praeterea cùm pulices habet, fasciculum mollis foeni ore accipit pilis involutum, seque paulatim posterius inchoando in aquam mergit, ac totum corpus, ut pulices aquam fugientes, ad caput ascendant. Deinde caput immergit, ut in foenum fugiant; quo facto, foenum relinquit in aqua, et mox enatat."

Besides, when he has fleas he takes in his mouth a bundle of soft hay rolled up in hair, and gradually immerses himself in the water back end first, and then his whole body, so that the fleas, trying to escape from the water, may creep up to his head. Then he draws his head under water that the fleas may be driven to take refuge in the hay, and when this has been done he lets the hay go in the water, and forthwith swims out.

The amusing figure which Olaus Magnus gives in illustration of the various cunning devices of foxes which he describes has been admirably reproduced by Mr. Edwin Wilson.

Foenum pilis involutum is not quite clear. Mr. Day does not remember anything about hay, and in Olaus Magnus's picture there is nothing like hair or wool shown; but the word is late Latin, and may be used as loosely as the modern "pile," which is either hair or the soft, fluffy nap taken off the surface of cloth. That is, however, unimportant. But I was given an interesting fact in corroboration of the probability that the fleas would readily betake themselves to wool. Miss Parsons, of Horseheath, a shrewd observer of natural phenomena and collector of folklore, told me that it was a common opinion among farm people that if poultry and poultry houses were infested by fleas the best way to get rid of them was to drive a flock of sheep among them, as every flea would take to the wool.

There is another point to be considered—I do not know that a fox is an animal much troubled by fleas. It may be that the curious procedure on the part of Mr. Day's fox was not a thing of common occurrence, but only when the animal had the misfortune to be suddenly attacked by an abnormal number; for great swarms of fleas do suddenly appear, not only on certain individuals or groups of animals, but on walls and wooden partitions. Some of your readers will remember the story of Dr. Michael Foster's dog and the fleas, which he carried in from a wall outside the house. I have myself seen the wooden frame of a hot-bed covered with them, and sometimes a hedgehog carries an enormous number.

A fox's calling takes him occasionally to hen houses, and commonly to earths frequented by hedgehogs, and he might therefore sometimes have to take strong measures to get rid of the excessive number of fleas he had carried from such places.

Mr. Day vouches for the truth of the story as I gave it in your issue of March 23, except that the hurdles and straw were put up to shelter him and his father, and not to protect sheep and lambs, for it was in July (1843).

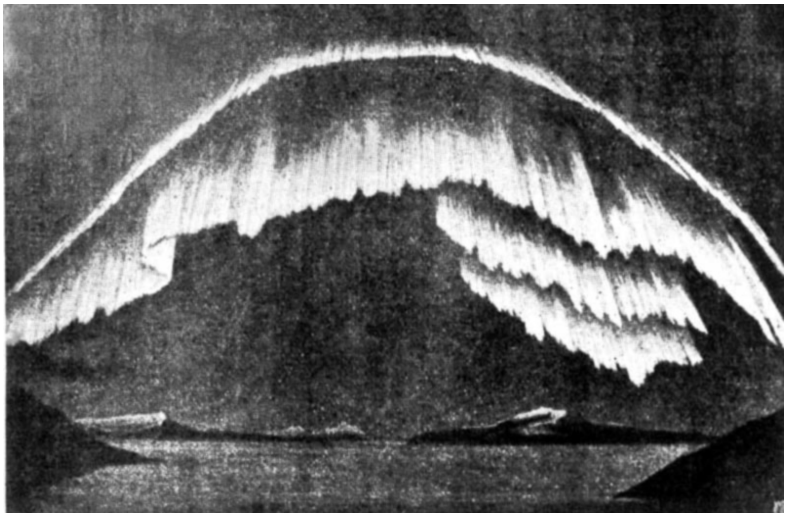
The fox went into a deep part of the small stream that runs by Mob's Hall into the Rhee or Cam near Thistlyground Farm, about a mile west of Guilden Morden.

T. McKenny Hughes.

Ravensworth, Brooklands Avenue, Cambridge.

The Radiation producing Aurora Borealis.

As is well known, Prof. Birkeland has put forward the hypothesis that aurora borealis and magnetic disturbances are due to an "electric radiation" coming from the sun. The numerous observations, partly from the regions near the auroral zone, treated by Birkeland in his work "The Norwegian Aurora Polaris Expedition, 1902–1903," as well as the theoretical work by Prof. Störmer, have shown that this hypothesis in a very satisfactory way accounts for the characteristic properties of aurora and magnetic disturbances, as well as regards occurrence as with respect to distribution in space relative to the earth.



The phenomena of aurora and magnetic storms, however, show a great variety of forms, and further knowledge will be required until we are able to follow every single phenomenon into details. From the point of view of Birkeland's hypothesis, it will be the next step to determine more definitely the properties of those "electric rays" which in the various cases produce the aurora and magnetic storms.

From the position of the auroral zone, Birkeland has already (*Comptes rendus*, 1910) estimated the average stiffness of the rays as measured by their deviation in a magnetic field, and he found that the rays are ten times as stiff as ordinary α rays.

The question would now naturally suggest itself, Is the "electric radiation" of the type of β rays consisting of corpuscles or of the type of α rays consisting of atoms? It is my intention in this note to direct attention to certain points which may guide us regarding this question.

As is well known, the law governing the absorption of the rays by matter is very different for the two types. The α rays penetrate matter in nearly straight-lined orbits, and only a very small fraction is scattered to any appreciable amount. The velocity of the α particle gradually diminishes as the particle passes through matter, and for a certain velocity it loses its power of ionising the mole-

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cules of a gas and to produce photochemical action. The number of ions produced per unit length along the path of the α particle has its maximum very near the point where it loses its ionising power. The β particles, however, are almost completely scattered in the first thin layer of matter, and inside it the radiation broadens out in all directions, and any trace of the direction of the impinging rays is soon lost.

In the aurora, according to Birkeland's theory, we are actually examining the luminosity produced when the electric radiation strikes the upper strata of the atmosphere, and from the form and structure of the luminosity we should be able to examine the way in which the solar radiation is absorbed by matter.

One of the most conspicuous forms of aurora are the draperies, of which an illustration is given in the accompanying figure. We notice the straight-lined structure. That the draperies are formed by something coming towards the earth from outside will be evident to all who have witnessed their formation. On March 27, 1910, the writer had the opportunity of examining a most brilliant aurora from the mountains of "Jotunheimen." Brilliant draperies were formed, and they could be seen actually falling down in the direction of the streamers, one bundle adding itself to another in rapid succession so as to form long spirals and bands. Now the structure of the luminosity is just as would be expected if the draperies were formed by a type of rays showing an absorption like that found for the α rays. Looking at the luminosity along the transverse streamers, we shall always notice that the intensity gradually increases downwards, but stops all of a sudden, just as it is found for the ionisation produced by an α particle along its path.

I do not mean to say that it is exactly α rays or charged helium atoms which produce draperies, but I think that the similarity in absorption strongly points to a similarity in type of radiation—in other words, that the rays producing the draperies are of atomic size and carry an electric charge.

The fact that the draperies occur mostly on the evening and night side of the earth should, according to the law of the magnetic deflection, require a negative charge of the rays; but such rays may well be possible, for, as we know, Sir J. J. Thomson has found that accompanying the positive rays in a vacuum tube there are other rays formed by atoms, but carrying a negative charge.

In view of the fact that a number of the same spectral lines are found in the corona and the aurora spectrum, which belong to the rare gases, it would be natural to suppose that these inert gases, *e.g.* argon, neon, xenon, krypton, helium, and possibly coronium, are forming the carriers of the "electric radiation" producing the draperies.

The existence of such radiation does not in any way exclude the existence of corpuscular rays; these may be the cause of the auroral "arch," which has just the diffuse appearance to be expected from the law of absorption of the β rays. Further, the magnetic disturbances may to a great extent be due to radiation of the β-ray type.

L. Vegard.

University of Christiania, March 16.

The Velocity of Earth Movements caused by the Messina Earthquake.

I am deeply indebted to Prof. J. Milne, F.R.S., who, in Nature of March 23, did me the honour of directing the attention of scientific men to my memoir on the velocity of earth movements caused by the Messina earthquake. As the notice contains some remarks on my work which require a little explanation, I beg to be permitted to state my views here.

According to some seismologists, the position of the hypocentre is at the intersection of an asymptote to Schmidt's hodograph, with a vertical ordinate drawn through its apex. It seems to me, therefore, that the absence of any measurable flexure in the curves may really mean that the hypocentre of the Messina earthquake was very shallow. That is, however, a matter of opinion about which seismologists can easily be divided, and I have no desire to insist on this subject.

Prof. Milne assumes that I divided the large-wave phase of the seismograms into three parts, called L_1, L_2, L_3, being L_1 the commencement of maximum motion, L_2 the maximum movement itself, and L_3 the phase which travels the slowest. He adds that if this is to be accepted as a definite and recognisable phase in a seismogram, there seems to be no reason why we should not also accept many other phases, which may be indicated by the letters L_4, L_5, L_6, &c. The remark is of interest, but I deserve neither praise nor blame for the division of the large-wave portion of seismological registrations. Prof. Milne well knows that the division of the principal portion of a seismogram into six groups was done by Prof. Omori, analysing the registrations obtained at Tokio, and such a division is now accepted by almost all seismologists. In my memoir, L_1 indicates the commencement of the initial phase; L_2 and L_3 are respectively the commencements of the slow-period and of the quick-period phases of the principal portion of the registrations, according to Prof. Omori's division.

Instead of considering as a whole the large-wave phase, which involves some uncertainty (as often the commencement of the principal portion is assumed to be on Omori's initial phase and at other times the commencement of the same principal portion is referred to the slow-period phase), I tried to distinguish in all seismograms the first three groups of the large-wave phase, L_1, L_2, L_3. I am not dissatisfied at having done this, because I have obtained some results which I think are not without importance for physical seismology.

I conclude by expressing my warmest thanks to Prof. Milne for his notice and for the valuable article on the necessity of restoring the Messina Observatory contributed by him to Nature of February 16.

Messina, March 30. G. B. Rizzo.

FROM THE NIGER TO THE NILE ACROSS AFRICA.[1]

Dr. KARL KUMM (whom, from the indirect statements made in his book, we take to be of Swiss origin, and who now seems to be for all practical purposes an Englishman) assisted to found the Sudan United Mission in 1907–8. This mission was expressly intended to work in the Nigerian and Egyptian Sudan to counteract the Moslem advance, and Christianise the pagan tribes of negroes not as yet influenced by the Muhammadan religion. His previous acquaintance with Africa (according to the statements made in his "exordium") has been considerable. In 1899 he had visited "the southern oases of the Libyan Desert," and had travelled a considerable distance on the way to Darfur. In 1901 he travelled in Nubia. In 1904 he journeyed from Tripoli southwards into the mountainous region north of Fezzan and studied the Hausa language. In 1904–5 he led an expedition of investigation into northern Nigeria. In the two following years he visited America and South Africa to arouse interest in his mission and secure data as to the advance of Islam in the direction of the Zambezi. On his return from South Africa he visited Portuguese East Africa, Mombasa, and made a hasty journey to Uganda.

In October, 1908, he left Liverpool with seven missionaries of the newly formed Sudan United Mission to visit or to found mission stations in northern Nigeria, and establish a home for freed slaves. He further intended, if practicable, to cross Africa along the border-line between Islam and paganism.

The book under review is the result of this last journey, which extended from Forcados, at the mouth of the Niger, along the course of the Benue to the Musgu country on the Shari, thence up the Shari River to Fort Archambault, and from that point along the line of water-parting (more or less) between the Shari, the Congo, and the Nile. He emerged into some-

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[1] "From Hausaland to Egypt, through the Sudan." By Dr. H. Karl W. Kumm. Pp. xiv+324. (London: Constable and Co., Ltd., 1910.) Price 16*s.* net.

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